BIOL 240 *GENERAL MICROBIOLOGY* (Part II) – Important Terms and Concepts 3/8/2020

4. **(4B:) Eukaryotic Cells: Membranes, Transport.** **Flagella & Cilia** (9+2 microtubules); Euk. Cell walls = **cellulose**, chitin, glucan/mannan; **Glycocalyx** = bonded sugars to amimal plasma membrane proteins and lipids. Cytosol, **Cytoskeleton** (actin microfilaments, tubulin microtubules, keratin/lamin intermediate filaments – very dynamic structure and movement, cytoplasmic streaming; **Endocytosis** (Phagocytosis, Pinocytosis) & **Exocytosis**, **Lysosomes**. Nucleus- nuclear pores, nucleolus; ER (smooth, rough), Golgi - cisterns, Vacuole,

- Mitochondria, Chloroplasts – thylakoids/ stroma/ grana; peroxisomes; Ribosomes, centrosomes/ centrioles; Rough ER, Smooth ER. **Prokaryotes vs. Eukaryotes**. ***Endosymbiosis Theory***.

5. **METABOLISM:** enzymes, cofactors, regulating enzyme activity (pH, temperature, [substrate]); coenzymes, **feedback inhibition**, reaction rate. Collision theory, Apoenzyme, Holoenzyme. **Denaturation**, **Competitive & Noncompetitive Inhibition**. Ribozymes, Enzymes, cofactors, **regulating enzyme activity**; coenzymes, feedback inhibition, reaction rate, Equilibrium, ***Activation Energy***, saturation. ***ENERGETIC COUPLING***. ***Proteins provide→ specificity, saturation, & competition to a process!!*** **Redox reactions**; Reduction, Oxidation; Dehydrogenation; **ATP.** Light & Chlorophyll; **NADH**.

- ***Substrate-level Phosphorylation:***
- Carbohydrate catabolism: Glycolysis (invest 2 ATP, harvest 4 = 2 net; 6C glucose →**2X** (3C Pyr + 2NADH), **2X** Pyruvate Oxidation (3C→ 2C Acetyl-CoA + NADH + CO_2); **2X** Krebs/TCA cycle (2C + 4C → 6C→5C + CO_2 + NADH→ 4C + CO_2 + NADH → ATP → $FADH_2$ → NADH; = **6 NADH, 2$FADH_2$, 4CO2, 2 ATP per glucose in TCA cycle**), Electron Transport Chain (ETC); **Proton Motive force**, **Chemiosmosis,**
- **Oxidative Phosphorylation = ETC + Chemiosmosis,** Ubiquinone/ coenzyme Q, Cytochrome C, Cytochrome C Oxidase, **O_2**; ***ATP Synthase***). **~2ATP/$FADH_2$, ~3ATP/NADH**. Prokaryotes harvest **38 ATP/glc,** Eukaryotes harvest **36 ATP/glc**.

- **Anaerobic Respiration**: Nitrate, Sulfate, or Carbonate electron acceptors – none yields as much energy as O_2. **Fermentation** = only **2 net ATP/glc;** organic electron acceptor with lots of energy left over – regenerates NAD+ for glycolysis. ***** Cell Respiration = electron transport!!***
- **Photosynthesis: Light reactions** harvest light as High Energy Electrons → ATP and ***NADPH*** → used to add CO_2 carbons to 5C RuBP → glucose/sucrose/starch!!! (**Carbon Fixation** in the **Calvin-Benson Cycle**/ **Dark Reactions**!!). Chemoheterotrophs, Chemoautotrophs, Photoautotrophs, Photoheterotrophs. ***Anabolic and catabolic pathways are tied together ("coupled" - - feed off of each other for Carbon and Energy)***!!
- **TROPHISMS: chemohetero-, chemoauto-, photoauto-, chemohetero-trophic organisms.**

6. **MICROBIAL GROWTH:** Physical Requirements (Temp = **psychro-, meso-, thermo-philes**; pH = **acido-, neutero-, alkalo-philes**; Osmotic pressure = **halophiles**/ "salt-lovers"); Chemical Requirements C, N, S, P & Trace elements; O_2 (toxic = Singlet, Superoxide, Peroxide anion, Hydroxyl radical): ***obligate aerobes, facultative aerobes, obligate an-aerobes, aerotolerant anaerobes, microaerophiles***. – **Superoxide Dismutase, Catalase, Peroxidase**. Culture Media: Chemically Defined, Differential, Selective. **Binary Fission**. **Bacterial/Microbial growth curve (lag, log, stationary, death phases).** Measuring growth: Plate counts, MPN test, Turbidity w/ spectrophotometer.

7. **GROWTH CONTROL:** Sepsis, Asepsis, Sterilization, Disinfection v. Antisepsis, **Bacteriostatic v. Bacteriocidal**. – Death at logarithmic rate! Depends on organic matter, pH, Temp, biofilms).

- Physical Methods: Heat (TDP, TDT) – Moist heat - ***Pasteurization***, ***Autoclaving***. Also: Filtration, low Temp, High Pressure, Desiccation, Osmotic Pressure, Readiation (ionizing – free radicals).
- Chemical Methods: Use-dilution test, Disk-diffusion method. TYPES (13): **Phenol / phenolics / bisphenols** (triclosan!) = denature proteins, dissolve membranes, Biguanides = disrupt membranes, **Halogens** = oxidizers (damage DNA, proteins, membranes), **Alcohols** = denature proteins, dissolve lipids, **Heavy metals** = *oligodynamic action*/ denature proteins, **Surfactants** = detergents & Quats = denature prots., disrupt memb., Food Preservatives = Organic acids, Nitrite, antibiotics – inhibit metab.; Aldehydes = crosslink, Gases = denature, Peroxygens = oxidize. ***Few Disinfectants are effective on endospores or mycobacteria!!***

Microbiology Midterm 2 (Spring 2020): Study Questions

Possible Short Essay Topics (*be prepared to DRAW diagrams as well!*):

1. **Ch. 4B: List and explain the significance of at least 8 differences that distinguish between "Prokaryotic" & Eukaryotic cells. Explain the functions of each of these cellular characteristics.**
2. Using diagrams, list and describe the major functions of at least 10 different Eukaryotic organelles, including those that differ between animal and plant/algal cells.
3. **Explain and draw the prevailing Theory for the Origin of mitochondria and chloroplasts in eukaryotic cells, and list 3 examples of supporting evidence.**

4. **Ch. 5: Diagram and describe how enzymes speed up chemical reactions, and explain how they affect the energy and equilibrium of a reaction. Describe *6* different physical and chemical factors that can regulate enzyme activity. *How do enzymes affect metabolism and growth??***
5. Diagram and describe an example of ***energetic coupling*** in a cell. Define energetic coupling.

6. ***Describe AND diagram* when and how six carbons in glucose are all transferred and released, and in what form (molecule), from glycolysis through the Krebs (TCA) cycle. *What else happens each time carbons are released??***
7. **Compare and contrast the energy inputs and outputs during each phase of aerobic respiration vs. fermentation. Include all phosphorylated compounds and high energy electron carriers, and briefly explain how these are produced at each stage of respiration.**
8. **DIAGRAM and briefly explain how and where energy from high energy electron carriers is converted to ATP during respiration in mitochondria and aerobic bacteria. Label each process involved in energy conversions, and label two of the proteins involved in the final steps of making ATP.** *(compare this to ATP production during Photosynthesis)*
   - *[hint: discuss electrons, gradients, and phosphates, and the proper terms for the pathways involved.]*

9. Draw a simple diagram showing how energy is captured from light in Photosynthesis, and then how this energy is used to capture carbons from atmospheric CO_2 during carbon-fixation in the Calvin-Benson cycle. *How is this process similar to Cellular Respiration?*
10. **Distinguish the carbon and energy sources for all of the trophisms: chemo-, photo-, hetero-, auto-, and combinations of each.**

11. **Ch. 6: List and describe the three types each of pH and temperature preferences for growth among diverse bacteria.**
12. Explain how **oxygen** can be both a required part of metabolism, and a toxin to the same microorganism. How do aerobes overcome this toxicity? Draw diagrams of the five different oxygen-related growth phenotypes in an agar deep tube.
13. **Diagram and thoroughly define each of the four phases of a typical bacterial Growth Curve. Explain what is happening to the cells during each phase? *Explain how enzymes and metabolism contribute to such growth patterns*?**

14. **Ch. 7:** Distinguish between ***Sterilization***, ***Disinfection***, and ***Antisepsis***, and give an example of a **physical** and a **chemical** method to accomplish each. Also, distinguish between **germistatic** activity, and **germicidal** activity of an antimicrobial agent.
    - *What microbes are most **resistant**, and most **sensitive** to antimicrobial treatments?*

****** NOTE: One ESSAY Question will likely be MANDATORY on this exam!!!***

- *****Bold-typed questions address especially important concepts and essays for Part II of the course!***
- ***TIP: For "comparison/contrast" or "distinguish" questions, use a table with explanations.***